**Undergraduate Research Opportunities Program, CFANS U of MN**
**Invasive Phragmites Control – Combining Chemical and Covering Treatments**
**Rachel Brown 5/30/2014**

Invasive phragmites is an emerging problem for wetlands in the great lakes basin. When left untreated, it can form large monocultures which decrease biodiversity, lower water levels, and alter nutrient cycles (Whyte). It has been shown that with persistence, phragmites is possible to control using herbicide over about seven years of treatment (Lombard). However, chemical treatments can harm native species populations and have long-term, unintended effects on the ecosystem. The goal of this study was to test a method of treatment that would reduce chemical use in managing phragmites.

The idea for this study came from the work I have been involved with at Berry Lake, Wisconsin. Invasive phragmites has recently been identified there, but the population is not very well established (the largest monoculture is about one third of an acre) and it's not known if it has a viable seed bank. That makes the immediate future a critical time for invasive species control efforts at Berry Lake. If allowed to spread further, the population will become very difficult to eradicate.

This fall, October 2013, volunteers began a multi-year foliar treatment using Rodeo. However, some property owners are reluctant to give the Berry Lake Association (BLA) permission to spray chemicals on their land. I've been working with the BLA to research an alternative control method that may be more acceptable to the public and less harmful to the environment.

Past studies suggest that treating phragmites with a combination of control methods may be significantly more successful than any single treatment method on its own (Rapp). We hypothesize that the combined treatments of the herbicide application and covering plants which have been cut back to prohibit photosynthesis might be significantly more effective than either treatment on its own. If such a treatment method is successful, phragmites control could be achieved faster and with smaller amounts of chemicals, making the BLA's control efforts more acceptable to the public and better for the environment.

**Methods**

Sixteen phragmites plants were transplanted from Berry Lake into 2 gallon pots and brought to the greenhouse at the University of Minnesota on October 20, 2013. We collected specimens as close in age, vigor, and size as possible by selecting 5 to 7 culms under two feet tall to place in each pot.

In the greenhouse, the pots were placed in trays of 3-4 inches of water in order to mimic the soil moisture conditions of the collection site. Plants were watered at least once every 3 days and were exposed to natural light as well as supplemental lighting as needed to create 16 hour days. The plants were already beginning dormancy, and required four months in the greenhouse to reach enough vigor to undergo the treatments.

The sixteen plants were divided into four groups of relatively equal vigor. This was done by measuring the total height of the shoots in each pot and dividing the pots into four groups such that the sum of the shoot heights for each group were as equal as possible. A random number generator was used to assign a treatment to each group. The four treatments were: herbicide treatment, cut and covering treatment, herbicide with cut and covering treatment, and a control (no covering or herbicide).

*Herbicide treatment:* On March 3, 2014 plants were sprayed with one application of Rodeo solution. A 10% solution was applied using a "spray until wet" technique, according to manufacturer advisory (Dow Agrosciences 8). Five weeks later (April 10, 2014), when the plants had yellowed significantly, they were cut at 2 inches from the base. The cut off portion was discarded.

*Cut and Cover Treatment (C and C):* On March 3, 2014 the plants in the C and C treatment were be cut to 2 inches and covered with a benthic barrier. The benthic barriers were 12 mil black plastic tarps to completely block light.

*Herbicide with Cut and Cover Treatment*: In this treatment, plants were sprayed with the same Rodeo application as above and after 5 weeks the plant were cut to 2 inches and covered with the same benthic barrier as described above.

*Control*: Plants were grown in the same greenhouse beside the other treatments plants with no herbicide or covering. They were cut to 2 inches with the rest of the plants on April 10, 2014.

On May 13, 2014 (four weeks after the plants were cut back), two types of measurements were taken. Visual observations were taken for height, number of culms, color, and overall vigor (on a scale from 1=dead, to 5=robust growth) will be measured. Photographs were also taken of each plant.

The second measurement was biomass regrowth calculated by dry weight in grams. All growing plant parts, stem, foliage, etc. was collected by pot. Soil was removed, and washed from roots. Plants were placed in a 100 degree F oven for 48 hours. The dry weights of each plant were measured, separating roots from shoots.

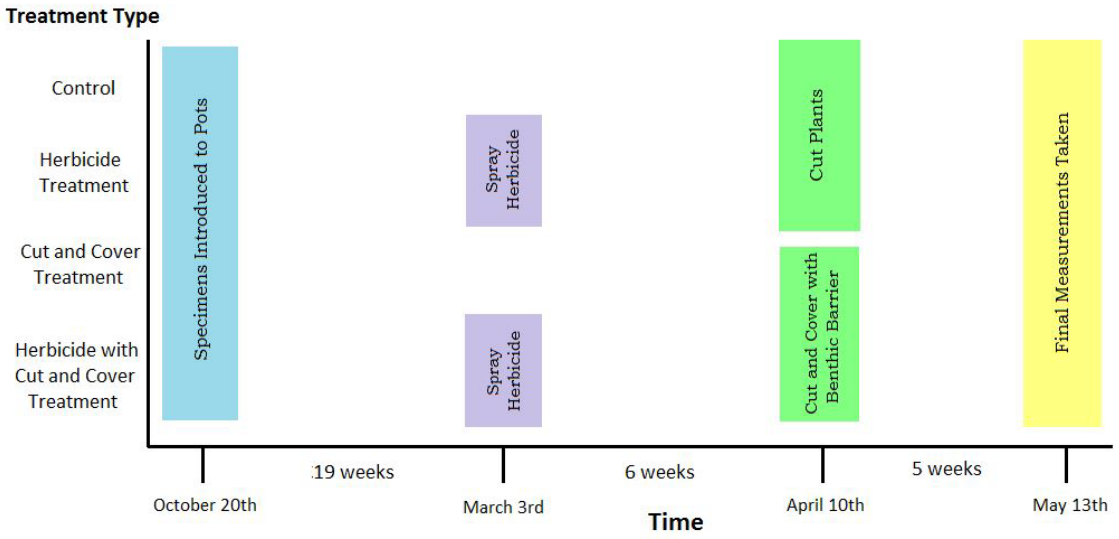


Figure 1: Timeline of experimental procedure

| | Total Shoot Height (in) | Number of Culms | Mass of Regrowth (g) | Color | Visual: Overall Vitality (1=dead 5=robust growth) |
|---|---|---|---|---|---|
| **Cover Only** | 400 | 64 | 3.5 | Pale green, yellow | 4 |
| **Herbicide Only** | 107 | 39 | 1.9 | Green | 2 |
| **Herbicide and Cover** | 304 | 77 | 2.9 | Pale green, yellow | 3 |
| **Control** | 250 | 32 | 5.5 | Green | 5 |

Figure 2: Total *Phragmites* shoot growth by treatment group.

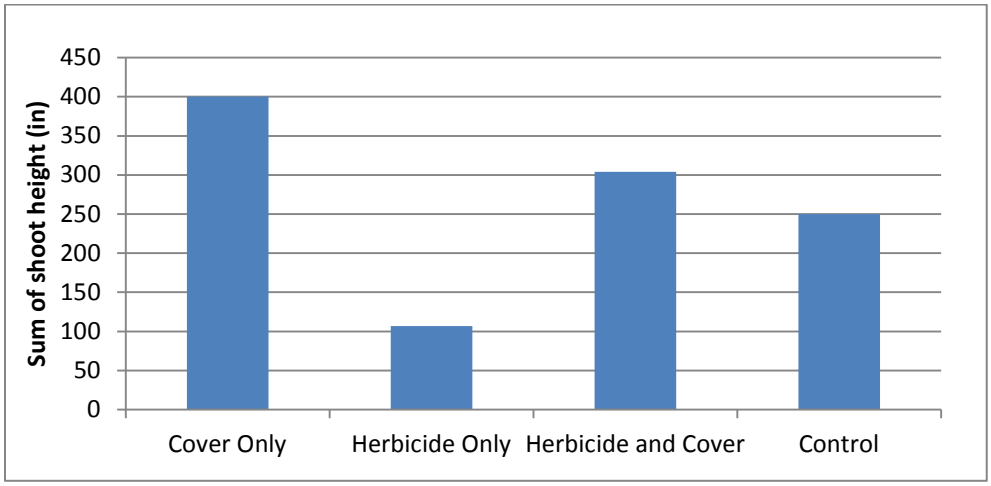


Figure 3: *Phragmites* shoot height by treatment group

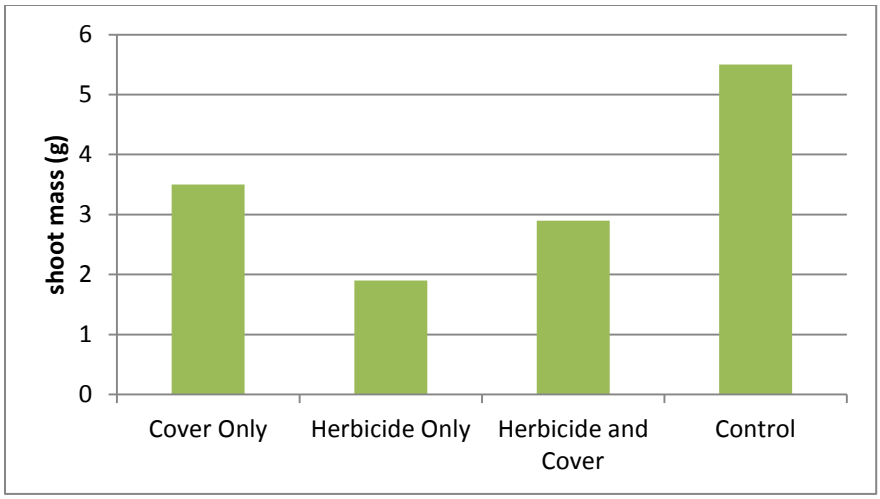


Figure 4: *Phragmites* Shoot Biomass weight by treatment group

**Discussion**

Contrary to the original hypothesis, the covered groups greatly accelerated their growth. They produced much more shoot length and many more shoots than the uncovered groups. This could be because the etiolation response from phragmites is very strong.

While the two covered groups produced about twice as many culms and much more culm height than the uncovered groups, their shoots were not as healthy. They contained less chlorophyll than the uncovered plants as an effect of etiolation. The shoots were also very weak and brittle. The covered groups produced much more shoot length than the control groups, but less shoot mass than the control. It is possible that over a longer period of time, covering phragmites may lead to an eventual weakening of the plant and decreased growth, but in the time frame of this study covering actually seemed to increase the plant's growth rate.

**Conclusion**

Our hypothesis was not supported by this experiment. Covering the plants to prevent photosynthesis did not seem to hinder the plant's growth but it actually accelerated it. This could be because the lack of light induced etiolation and accelerated growth in order to reach the light. Based on the results of this study, it appears that the use of herbicide without covering is the most effective option for phragmites control.

Another study may get different or more conclusive results if the re-growth period is longer. Even though the covered groups displayed accelerated growth initially, more negative effects from this type of treatment would likely occur in the long term. It would also be helpful to weigh the rhizomes prior to planting them to allow the comparison of the final mass of the plant to its initial mass. This would make it possible to observe the effects of different treatments on rhizome growth in addition to shoot regrowth.

**Appendix**

*Figure 6: Taken April 10th before cutting and covering all plants. Herbicide was applied 6 weeks before the photo was taken and the effect can be seen.*

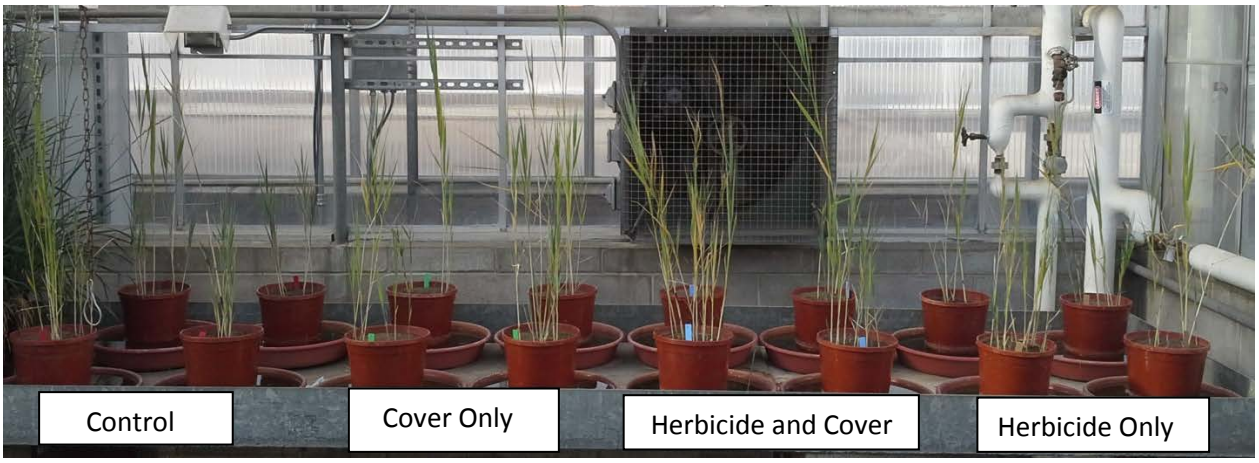


*Figure 7: Taken April 10th after cutting and covering the plants. This stage lasted approximately 5 weeks.*


*Figure 8: Taken on May 13th, showing regrowth that occurred in each group during the 5 weeks after treatment.*

**References**

Dow Agrosciences. Rodeo Herbicide Specimen Label. Indianapolis, IN: Dow Agrosciences LLC, 2006

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